

WHAT IS CLAIMED IS:

1. A surface acoustic wave device using a Shear Horizontal type surface acoustic wave, comprising:

a quartz substrate; and

at least one interdigital transducer disposed on the quartz substrate and including electrodes having a larger mass-load effect than that of aluminum;

wherein a metallization ratio "d" and a normalized film thickness  $h/\lambda$  of the at least one interdigital transducer are within specific ranges such that a ripple caused by a transversal mode wave is about 0.5 dB or less, where " $\lambda$ " is the wavelength of the surface acoustic wave and "h" is the film thickness of the electrodes of the at least one interdigital transducer.

2. A surface acoustic wave device according to Claim 1, wherein the at least one interdigital transducer includes at least one electrode layer made from a metal having a larger mass than that of aluminum.

3. A surface acoustic wave device according to Claim 1, wherein the at least one interdigital transducer is made from a single metal having a larger mass than that of aluminum.

4. A surface acoustic wave device according to Claim 1, further comprising a plurality of the interdigital transducers arranged to constitute a longitudinally coupled resonator filter.

5. A surface acoustic wave device according to Claim 4, further comprising a plurality of the longitudinally coupled resonator filters, which are connected in a cascade arrangement in at least two stages.

6. A surface acoustic wave device according to Claim 1, wherein the at least one interdigital transducer is arranged on the quartz substrate to constitute a one-port surface acoustic wave resonator.

7. A surface acoustic wave device according to Claim 1, wherein a plurality of the interdigital transducers are disposed on the quartz substrate;

each of the plurality of interdigital transducers constitutes a one-port surface acoustic wave resonator; and

the plurality of the interdigital transducers are connected to constitute a ladder-type filter on the quartz substrate.

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8. A surface acoustic wave device according to Claim 1, wherein a plurality of the interdigital transducers are disposed on the quartz substrate;

each of the plurality of interdigital transducers constitutes a one-port surface acoustic wave resonator; and

the plurality of the interdigital transducers are connected to constitute a lattice-type filter on the quartz substrate.

9. A communication device comprising a surface acoustic wave device according to Claim 1.

10. A surface acoustic wave device using a Shear Horizontal type surface acoustic wave, comprising:

a quartz substrate; and

at least one interdigital transducer disposed on the quartz substrate and made from tantalum;

wherein a normalized film thickness  $h/\lambda$  of the at least one interdigital transducer is within a range of about  $0.6d + 1.65$  to about  $0.6d + 1.81$ , where "d" is the metallization ratio of the interdigital transducer, " $\lambda$ " is the wavelength of the surface acoustic wave, and "h" is the film thickness of the electrodes of the at least one interdigital transducer.

11. A surface acoustic wave device according to Claim 10, further comprising a plurality of the interdigital transducers arranged to constitute a longitudinally coupled resonator filter.

12. A surface acoustic wave device according to Claim 10, further comprising a plurality of the longitudinally coupled resonator filters, which are connected in a cascade arrangement in at least two stages.

13. A surface acoustic wave device according to Claim 10, wherein the at least one interdigital transducer is arranged on the quartz substrate to constitute a one-port surface acoustic wave resonator.

14. A surface acoustic wave device according to Claim 10, wherein a plurality of the interdigital transducers are disposed on the quartz substrate;

each of the plurality of interdigital transducers constitutes a one-port surface acoustic wave resonator; and

the plurality of the interdigital transducers are connected to constitute a ladder-type filter on the quartz substrate.

15. A surface acoustic wave device according to Claim

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10, wherein a plurality of the interdigital transducers are disposed on the quartz substrate;

each of the plurality of interdigital transducers constitutes a one-port surface acoustic wave resonator; and

the plurality of the interdigital transducers are connected to constitute a lattice-type filter on the quartz substrate.

16. A communication device comprising a surface acoustic wave device according to Claim 10.

17. A surface acoustic wave device using a Shear Horizontal type surface acoustic wave, comprising:

a quartz substrate; and

at least one interdigital transducer disposed on the quartz substrate and made from tungsten;

wherein a normalized film thickness  $h/\lambda$  of the at least one interdigital transducer is within a range of about  $0.6d + 0.85$  to about  $0.6d + 1.30$ , where "d" is the metallization ratio of the interdigital transducer, " $\lambda$ " is the wavelength of the surface acoustic wave, and "h" is the film thickness of the electrodes of the at least one interdigital transducer.

18. A surface acoustic wave device according to Claim

17, wherein the normalized film thickness  $h/\lambda$  is within a range of about 0.6d + 1.00 to about 0.6d + 1.23.

19. A surface acoustic wave device according to Claim 17, further comprising a plurality of the interdigital transducers arranged to constitute a longitudinally coupled resonator filter.

20. A surface acoustic wave device according to Claim 19, further comprising a plurality of the longitudinally coupled resonator filters, which are connected in a cascade arrangement in at least two stages.

21. A surface acoustic wave device according to Claim 17, wherein the at least one interdigital transducer is arranged on the quartz substrate to constitute a one-port surface acoustic wave resonator.

22. A surface acoustic wave device according to Claim 17, wherein a plurality of the interdigital transducers are disposed on the quartz substrate;

each of the plurality of interdigital transducers constitutes a one-port surface acoustic wave resonator; and

the plurality of the interdigital transducers are connected to constitute a ladder-type filter on the quartz

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substrate.

23. A surface acoustic wave device according to Claim 17, wherein a plurality of the interdigital transducers are disposed on the quartz substrate;

each of the plurality of interdigital transducers constitutes a one-port surface acoustic wave resonator; and

the plurality of the interdigital transducers are connected to constitute a lattice-type filter on the quartz substrate.

24. A communication device comprising a surface acoustic wave device according to Claim 17.

25. A method for manufacturing a surface acoustic wave device using a Shear Horizontal type surface acoustic wave, comprising the steps of:

preparing a quartz substrate;

forming a metal film having a larger mass-load effect than that of aluminum on the quartz substrate; and

patterning the metal film to form at least one interdigital transducer by one of reactive ion etching and a lift-off process such that a metallization ratio "d" and a normalized film thickness  $h/\lambda$  of the at least one interdigital transducer which makes a spurious transversal

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mode ripple to be about 1.5 dB or less are satisfied, where "d" is the metallization ratio of the interdigital transducer, " $\lambda$ " is the wavelength of a surface acoustic wave, and "h" is the film thickness of the interdigital transducer.

26. A method according to Claim 25, wherein the metal film is made from tantalum, and patterning is performed such that the normalized film thickness  $h/\lambda$  is within a range of about  $0.6d + 1.50$  to about  $0.65d + 1.87$  to form the at least one interdigital transducer.

27. A method according to Claim 26, wherein patterning is performed such that the normalized film thickness  $h/\lambda$  of the at least one interdigital transducer is within a range of about  $0.6d + 1.65$  to about  $0.6d + 1.81$ .

28. A method according to Claim 25, wherein the metal film is made from tungsten, and patterning is performed such that the normalized film thickness  $h/\lambda$  is within a range from about  $0.6d + 0.85$  to about  $0.6d + 1.30$  to form the at least one interdigital transducer.

29. A method according to Claim 28, wherein patterning is performed such that the normalized film thickness  $h/\lambda$  of the interdigital transducer is within a range from about

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0.6d + 1.00 to about 0.6d + 1.23.

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